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5/10/94

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 5
77 WEST JACKSON BOULEVARD
CHICAGO, IL 60604-3590

REPLY TO THE ATTENTION OF:

W-15J

Date: May 10, 1994

Subject: Results of Meetings, March 23-24, 1994

From: Howard Zar, Chair, Great Lakes Sediment Task Force

To: Members, Great Lakes Sediments Task Force

This package is being sent to identified members of the Great Lakes Sediment Task Force as well as others who attended the March 22 - 23, 1994 meetings of the Sediment Quality Criteria and the Sediment Cleanup Goals Workgroups.

Enclosed are the following:

1. **Minutes of the Sediment Quality Criteria (SQC) and Sediment Clean-up Goals Workgroup Meetings** - The minutes were prepared by Region 5 staff and have the concurrence of Mary Schubauer-Berigan and Bonnie Eleder, who chaired the meetings. While it may have been useful to produce detailed minutes for the first couple of meetings, the effort has taken too much time. In the future, we intend a brief meeting summary, including action items, and any products of the meeting. Those who disagree may be asked to produce the minutes.

2. **Summary of the Sediment Cleanup Goals Workgroup Meeting** - prepared by Bonnie Eleder, chair. Note that Bonnie's materials contain a **revised schedule** on the last page of her document, including a meeting proposed for **June 29, 1994** in Chicago.

3. **Sediment Quality Criteria Workgroup: Comment Letter** - A copy of the letter Mary Schubauer-Berigan sent on behalf of the Workgroup is enclosed. A similar letter, transmitting the identical attachment, signed by Region 5 (and perhaps Region 2 and 3) officials, is in preparation. Linda Holst has agreed to be the co-chair of the Sediment Quality Criteria Workgroup, as discussed at the Great Lakes Sediment Summit. Ms. Schubauer-Berigan and Ms. Holst propose no further meetings now, pending the results of the meeting of the Cleanup Goals Workgroup.

4. **FAX Sheet** - Please comment by FAX to Bonnie Eleder on the proposed revised schedule as soon as possible.

5. **HydroQual, Inc. Newsletter** - This article may be of interest to Task Force Members, since it contains a discussion of SQC methodologies.

6. **Update on the Data Management Workgroup** - $150,000 in USEPA FY 94 funds is available to fund the database improvement effort in Region 5. Discussions are ongoing with Michigan, Minnesota, Wisconsin, and Ohio. New York has previously received funds from Region 2. A meeting or conference call is intended after the funding process is further along. The contact is Ken Klewin.

7. **Update on the Collaborative Sediment Remediation "Pilot"** - Michigan has proposed that the sites for the pilot project be in the "Southeast Michigan Initiative" (SEMI) area, on the Detroit River. The contacts at this point are Scott Cornelius and myself.

Thank you again for your participation. Questions or comments may be referred to the individuals named above or myself. Phone and fax numbers are contained in the first attachment.

We look forward to seeing many of you on June 29th, if the date holds.

Attachments, as stated

Great Lakes Sediment Quality Criteria Workgroup, and Sediment Clean-up Goals Workgroup Meeting Summary

March 22 and 23, 1994
Region 5, Chicago, Illinois

Sediment Quality Criteria (SQC) Workgroup (Mary Schubauer-Berigan chaired this portion of the meeting.)

The Sediment Quality Criteria Workgroup discussed the fact that SQC were designed to be Clean Water Act Section 304(a) criteria in the water program. Questions were raised as to whether and how the SQC are to be used to set clean-up goals, and whether SQC are Applicable or Relevant and Appropriate Requirements (ARARs) or "To Be Considered" in the Superfund program.

Cleanups conducted under CERCLA are required to attain legally applicable or relevant and appropriate standards (ARARs), requirements, criteria or limitations of all Federal and duly promulgated State environmental and public health laws. In situations where both Federal and State standards, etc., exist, the State's is the ARAR when it meets both of the following conditions: it is more stringent than the Federal standard, requirement, or limitation; and it is generally applicable and legally enforceable. In addition to laws and regulations, Federal and State programs may develop criteria, advisories, guidance, and proposed standards that are not legally binding, but that may provide useful information or recommended procedures. These are called "To Be Considereds" and are evaluated when ARARs do not exist for a contaminant or condition or the ARAR may not be sufficiently protective. The analysis of ARARs and TBCs help establish cleanup goals and identify preferred remedial alternatives. EPA may waive an ARAR for site specific situations if certain criteria as specified in the Superfund law are met. The Superfund reauthorization package currently eliminated ARARs for cleanup goals, replacing them with national standards.

States are required to adopt water quality standards equal to or more stringent than Federal water quality criteria. Most of the Great Lakes States have complied with this. Once adopted, the water quality criteria becomes ARARs.

Region 5 is not requiring States to adopt SCQ at this point.

There was no debate about the technical soundness for the SQC for use in the water program. There is confidence in the scientific basis behind the SQC.

A concern was expressed that the SQC do not take bioavailability into account, and that because of that the values derived will possibly not be as restrictive as the current numbers used to leverage clean-ups. A concern was raised that SQC do not address other problems such as fish tumors or other abnormalities.

The Federal Register notice asks for comment on two specific issues:

1. Scientific approach and validity of the SQC; and,
2. How should the SQC be used?

The SQC are designed to be protective of benthic organisms, specifically arthropods. A concern was raised that the SQC may not be protective enough because they are trying to protect the environment by looking at chemistry only, which is really a small part of the overall assessment. This scheme may not work for dioxin and PCBs. The limitations on the uses of the SQC should be clarified. For each program it must be decided what risk management decisions should be based on the SQC.

Representatives of Michigan and Wisconsin discussed what was being considered in their SF and Water programs on adoption/use of SQC.

MI--In Superfund there is a concern that the PRP will say "That's a mandatory number, we won't go below it (to clean up more.)" There is also a concern that if the State adopts the criterion, in some cases it could be too high. Could go either way--drive unnecessary clean-up or prevent appropriate levels of clean-up. MI needs a time period to test the SQC; does not want the SQC to be ARARs yet. There must be accompanying language with the SQC describing the limits of their use. MI's Environmental Response Act applies to soil, groundwater, and sediment. It does allow some clean-ups to be less than totally "clean." MI felt the SQC could be adopted as ARARs only if there were a statement that they were to be used "unless otherwise demonstrated" that a different standard were appropriate.

WI--The WI DNR does not believe the SCQ should be ARARs, but should be a screening tool, "to be considered," one of several "flags." WI felt it important to focus on helping quantify a process to be used to arrive at a clean-up number, to establish a "weight of evidence" to support a cleanup decision and a cleanup goal. There is a need to answer the question, how do you get from a SQC to a clean-up number, considering technical feasibility, cost, environmental impact, and other factors. Currently it is written into the law that the top concern is human health--and then the question of cost comes into play. In practice it doesn't always happen that way. A consistent approach would be desirable.

The discussion moved to the chemicals selected. Several States felt that the chemicals that were selected for SQC were not of major concern in the Great Lakes. HQ acknowledged this was true, but stated that the chemicals were chosen because we have a lot of information about them.

A "User's Guide" for SQC will be prepared by EPA HQ, which will include an appendix on each program. A draft is expected in the Fall. The States will be asked to review and comment on these documents. The User's Guide will be updated as new SQC are developed for additional chemicals. The Sediment Quality Criteria Workgroup agreed to ask for an opportunity to participate in the early stages of drafting the "User's Guide."

The question was asked whether the SQC could ever be applied "across the board" as is the case of water quality standards. HQ answered that the SQC would be modified with considerations of other factors such as acid volatile sulfides (AVS).

A list of possible recommendations was generated based on the above discussions. **The enclosed letter signed by Mary Schubauer-Berigan captures the final agreement of the group, and incorporates the later comments of New York and Region 2.**

Setting Clean-up goals at a Superfund Site in an AOC
Presentation by Mary Schubauer-Berigan

The State has the lead on SF sites in MN. The following is a description of a site on the St. Louis River, an AOC:

- Old steel mill, had PAH, Hg contamination
- Data were old, unreliable
- Point source discharge was stopped 15 years ago
- Theory was to "allow clean sediments to naturally cap contaminated sediments"
- Surficial poling reveals: sediments not improving

Conclusion was that the sediment situation had to be revisited. In 1993 the State did a sediment survey. Most contamination was found near the settling pond of the steel mill. This was near a beautiful, forested site, with eagles.

1993 Sediment Survey
- 8 cores were taken per 60,000 square meter area
- Acute and chronic tests on grab samples
- Benthic survey performed at corresponding sites
- Visible contamination throughout core
- Contamination was 3-6' deep
- 15 to 25 PAH compounds detected in most sections--pyrene, fluoranthene, phenanthrene and acenaphthene most common

This site is a good "test case" for the use of the proposed SQC, because three of the proposed criteria were exceeded (up to 100X).

Clean up Goal Approach

- Use grids to establish area of contamination delineated per core
- Determine whether OC-normalized compounds correspond to chronic toxicity or benthic community survey data at each site
- If "yes," use existing SQC to determine extent of remediation required
- If "no," determine total PAHs, compare to SLC and AET values for exceedences
- Use adjusted-TOC normalized individual concentrations to determine sediment clean-up goal
- Use clean-up goal in risk management decision

The question is how to determine the correspondence between the SQC and the benthic toxicity. MN has considered an AOC-wide criterion but do not know how to relate SQC to clean-up goals. A site specific criterion would provide a best estimate of the effect on the benthic community. TOC is elevated by PAHs, and if the TOC of the parent material is determined, it might be possible to set clean-up goals based on the TOC.

What is Adjusted TOC?

- Determine at each location, what is TOC of parent material (i.e., that at sub-contaminant layers)?
- presume remediation will affect organic carbon concentration. . .establish acceptable clean-up numbers on a "worst case" basis

Other Approaches Being Considered?

- AOC-specific apparent effects, threshold to establish "safe" concentrations
- Using background PAH concentrations in AOC as clean up goals (WI stated that 3.6 ppm "urban background" is used there.)
- Toxicity-based clean-up (keep shoveling until its not toxic anymore, testing with mobile toxicity-tester, "grab" samples on site.)

Major Stumbling Blocks?

- How does Hg fit into all this?
- How do we derive criteria for compounds not on the federal list? Technical manual method is very difficult and lengthy
- Will photoactive toxicity be the next regulatory strategy, and should we be dealing with that now?
- How is the interaction among criteria compounds (especially PAHs) being factored into the SQC?

The Working Group discussed various site characterization issues and priorities:

- Identify the "hot spots" and go after the worst first.
- Need to have all involved agree on what the endpoints are that will define when you are "done."
- SCQ don't help to define clean-up goals in the following case--cost is so great that you cannot hope to clean the site up

totally, how do you prioritize and select remedy?
- Issue is how to get the biggest bang for the buck in selecting among remediation options/prioritizing among hotspots.
- Big issue in the Regions is how to explain to the public that decisions are being made to minimize risks.

The group agreed that a consistent approach to defining clean-up goals would be would be useful. The following list of considerations was generated.

Uniform Thinking on Translating SQC to Sediment Clean-up Goals

- Define the problem, using the "triad approach." Define the range of endpoints and then look at how much money you have and see how protective you would be.
- How deep, wide, toxic: goal is fishable, swimmable, protect human health.
- QAQC--What are we doing, why?
- DQO--Data quality objectives
- Do you have information? What information is it? Age? Quality? Has the condition of the site changed?
- Resources
- Time

WI passed out the chart/decision tree it developed. The group agreed that there were many existing "decision trees" that should be considered. The following list was generated:

Existing Decision Trees

- IJC Appendix from RAP
- Wisconsin's Chart: Weight of Evidence Approach
- GLNPO Integrated Assessment Document
- Dredging "4-Tier" approach
- RAP "Triad-Based" Approach
- Environmental Science and Technology (Compendium-based)

The question was raised, is an approach to reach clean-up levels what the group would like to see in the proposed User's Guide? And what factors should be taken into account, such as cost, toxicity, and bioaccumulation. After some discussion about a "cookbook" approach, the group felt it was desirable to try to arrive at a consensus "decision tree." The group decided to recommend that these decision trees be considered by HQ in developing the User's Guide.

It was pointed out much of this would be the subject of tomorrow's discussion on clean-up goals.

Summary: Are States Prepared to Adopt SQC Into State Rules?
MN--is ready and intends to do so
PA--will use on a site-specific basis

IN--would like to have consistency of approach; SQC may be used in NPDES permits; not sure about adoption of SQC
OH--unsure
IL--any adoption of SQC would be in the far future
WI--eventually would like to adopt SQC but the application is very far-reaching. Tremendous amount of work, political and substantive before could think about SQC adoption. WI is not opposed to SQC, but would like to have a statement like in the water quality rules "no toxics in toxic amounts in the sediment" and then have a guidance on what is involved in the process of setting clean-up goals. Would rather put money into clean-up than debating theoretical clean-up goals.
MI--Has adopted revised WQS, but no discussion of SQC.
NY--?

The question as to the benefits of State implementation was raised. MN believes that adoption of SQC may help to leverage clean-ups. It was stated that adoption of SQC may help in doing a numerical interpretation of narrative criteria so that states could do better pollution prevention.

The consensus seemed to be that there is no rush among the States to adopt SQC, and that creating a model or a consistent decision tree for use in the Basin to reach clean-up goals in a consistent manner across programs is considered most important.

<u>Interim Standards for Great Lakes Toxics</u>

The group discussed whether is was desirable to try to set interim clean-up goals for those toxics of greatest concern.

An attempt was made to list currently used methodologies and clean-up levels derived from them for PCBs by the States and Regions.

Authority	Approach	Endpoint	Clean-up Level	Notes
MN	BSAF	10^{-5} cancer risk	5-600 ppb	Normalized for Organic Carbon
WI	BSAF	FDA action level in fish (2ppm)	200 ppb	Normalized for Organic Carbon
OH	Sediment Ingestion	10^{-6} cancer risk	1.6ppm (resid) 3.2ppm (indus)	Not normalized
WI	BSAF	0.05 ppm in fish	5ppb (fish advisory)	

It appeared that biota to sediment accumulation factor methodology (BSAF) was the most favored approach. Region 5 (Amy Pelka) discussed a draft document that describes various BSAF approaches, and makes recommendations. The draft is in internal review now, but will be available for comment by the States by May or June of 1994.

BSAF needs more field verification. There is an issue of how to deal with different species of fish (variable uptakes), and fish whose lifecycles cause them to move over different degrees of contamination in the sediment. The question relates to where the fish live, and for how long, in relation to contaminated sediment sites.

Public Outreach

Barbara McLeod discussed the public outreach aspects of the overall Great Lakes Toxics Reduction Effort. A proposal is under development for a Basin-wide Public Forum, that would be a Federal Advisory Committee Act-chartered group.

At the working group or Task Force level, there is a desire to have outreach to the public, regulated community, other Federal agencies, at some point early in the process. It was suggested that the components of the "User's Guide" or decision trees might be a good subject for a public meeting.

There was discussion of the benefit of such outreach. It was pointed out that there is an educational benefit--and countered that there has been a lot of outreach on sediments recently through the ARCs program. Several stated that it is too early in the process for public involvement; there is a concern that "we don't have our act together" enough to go public. It was also pointed out that it is acceptable to seek public input before a course is set in stone--some good ideas and new directions can result. Openness can be useful in anticipating public comments later. There was some concern that the public doesn't really care what the decision trees are--they just want the site cleaned up.

The group deferred a recommendation on the next steps for public outreach.

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*Attended Day 2 Only.
**Attended Day 1 Only.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION V

77 West Jackson Boulevard
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DATE: May 4, 1994

FROM: Bonnie L. Eleder, Chair Bonnie
Sediment Cleanup Goals Workgroup

TO: Sediment Cleanup Goals Workgroup members

SUBJECT: March 23, 1994 Meeting Summary

The Sediment Cleanup Goals (SCG) Workgroup held a meeting on Wednesday, March 23, 1994, at USEPA offices in Chicago. Water, Superfund/Waste and other programs from the eight Great Lakes State Agencies and USEPA Regions 2 and 5 were represented. The purpose of the meeting was two-fold: 1) to clarify the workgroup's goal, and 2) to delineate the activities to be undertaken to reach this goal. Suggested language for the goal and a number of questions to think about and potential activities to consider had been provided to workgroup members prior to the meeting.

Discussion was initiated regarding the goal of the workgroup. The issue of SCGs is broad, encompassing regulatory requirements, methodologies to generate numbers, and SCG implementation considerations, and how all of this fits into risk-management decision-making. The workgroup began with a brainstorming session to list the regulations, guidelines, and methodologies relating to SCGs. This list included:

- Toxic Substances Control Act - 50 ppm regulatory limit; 2-50 ppm treatment level requires TSCA approval for disposal
- Superfund Guidance for Soils - residential 1-10 ppm; industrial 10-25 ppm
- Resource Conservation & Recovery Act - regulated if mixed with a RCRA hazardous waste
- State of Michigan - soils 1 ppm; sediment numbers to be developed
- 1977 Interim Guidelines
- Green Book (4 Tier approach); Great Lakes Dredged Material Testing Manual
- 1983 Ontario Guidelines - lowest, moderate, and severe effects levels
- BSAF and other methodologies (AET, EqP. Triad)
- NOAA
- Long & Morgan - apparent effects thresholds concentrations

NYDEC - Technical Guidance; Estabrook's approach
State of Washington - marine sediments
ARCS - integrated assessment (problem definition)
EPA Sediment Compendium
EPA Sediment Fact Sheets

This exercise helped focus the thinking toward cleanup numbers and how they are generated. It was recognized that the process of developing a SCG has two parts - generating the number, and its implementation. Implementation was recognized to be Program/Agency-specific and that the real focus of the workgroup should be on developing a technically-sound methodology for generating SCGs. The workgroup may tackle the issue of implementation later, or, may merge with those other interested individuals to form a working group under the Great Lakes Sediment Task Force and offer to work with USEPA HQ in the development of the Sediment Quality Criteria User's Guide.

SCG Workgroup Goal: To develop an appropriate model approach for developing technically-sound sediment cleanup goals for contaminated sediment sites in the Great Lakes Basin.

The discussion next centered on the overall approach for the methodology. The idea of using a decision-tree framework was agreed upon. Decision-trees will be developed for the pollutants identified by the workgroup in the following order of priority: total PCBs, heavy metals, mercury, PAHs, and dioxin. These decision-trees would be "user friendly" tools that project managers/decision-makers could utilize at Great Lakes sites. Through the decision-tree, a SCG would be developed that is site-specific for the type of threat/harm/risk to be protected against. For example, if PCBs are the contaminant of concern and have been found in fish that a subsistence population would likely consume, the decision-tree framework would steer the project manager to an appropriate methodology to generate a PCB SCG to protect this human health risk.

A number of steps were established that the workgroup will follow in developing the decision-trees for each of the priority pollutants identified above. The following lists these steps, expanding upon that developed at the meeting. Your input on this process would be appreciated. [Is anything missing? Is it a logical progression?]

1. develop basic framework of decision-tree

2. assemble the following currently available detailed information: (a) risk information relating specific potentially exposed populations, migration pathways, and effects, and (b) models to generate sediment numbers

3. "1" and "2" distributed for review by workgroup members

4. conference call or meeting to review comments from "3"

5. decision-tree revised as necessary incorporating risk information, models, and any other comments resulting from "4"

6. revised decision-tree from "5" is distributed for initial peer review at respective agency/program

7. meeting 4-6 weeks later; results of peer reviews presented

8. final draft of decision-tree completed incorporating agreed upon modifications resulting from peer review

9. run a pilot test(s) of decision-tree for a fictitious case study (ies); write-up results of pilot testing

10. prepare a User's Guide based on pilot testing; distribute pilot testing write-up and User's Guide to members for review

11. conference call or meeting to discuss results of review, decide "what's next" once finalized

12. preparation of a draft guidance document incorporating decision-tree, pilot testing, user's guide

13. distribute to members for review

12. conference call or meeting to discuss review comments and revision of draft guidance

13. finalize draft guidance document

14. members distribute for final peer review at respective agency/program

15. conference call or meeting to discuss results of peer review and finalization of document

16. ?present to management of agencies\programs?

The basic framework for a PCB decision-tree was completed at this meeting (step 1). A copy is attached. (Note: The decision-tree will be typed at a later date.) Assumptions were made for the decision-tree that certain activities and decisions would need to be completed before a SCG could be developed. These assumptions are:

1. sufficient site characterization/assessment has been completed
2. documentation of unacceptable risk(s) to human health and/or the environment exists
3. a decision has been made that an action is warranted at the site

The framework for developing the information regarding potentially exposed populations, migration pathways, and effects for PCB-contaminated sediments was assembled by the workgroup and is provided below:

<u>Human Health</u>
direct contact/dermal via surface water and sediment
ingestion via surface water and sediment
fish ingestion
inhalation

<u>Aquatic</u>
acute and chronic toxicity
growth/reproduction
benthic community structure
water column community structure
fish tumors/abnormalities
bioaccumulation
biomagnification

<u>Terrestrial</u>
acute and chronic toxicity
growth/reproduction
tumors/abnormalities
bioaccumulation
transport/migration

Several members volunteered to assemble the information (i.e., put together "straw" proposals) for step 2. They are:

Amy Pelka (USEPA 5, Water) - human health
Lee Liebenstein (WDNR) - aquatic
Scott Cornelius (MDNR) - terrestrial

(Note: Tom Janisch has provided the aquatic risk package. A proposed date of May 20 is being made for the other packages.)

A schedule was established during the meeting; but a revised schedule is provided below for your consideration:

May 20: "straw" proposals due to me for distribution to workgroup members (step 2)

May 27: risk information distributed to workgroup members

June: review of decision-tree and risk information by workgroup members (step 3)

June 29: meeting to discuss results of review and assemble risk and models information into decision-tree (steps 4 & 5)

July: distribution for initial peer review (step 6)

August: conf. call or meeting to discuss results of initial peer review (step 7)
complete final draft of decision-tree (step 8)

Sept.: pilot testing (step 9)
develop User's Guide (step 10)

Also, it was determined that those who attended the March 23 meeting will comprise the core of the SCG Workgroup. Other persons on the mailing list will continue to receive all mailings and may participate on the workgroup to whatever extent they may want to.

I would appreciate any feedback from you on the process and schedule outlined above. My telephone number is 312-886-4885. Please feel free to call me if you have any comments, questions, etc.

a:\scgwg.1

Minnesota Pollution Control Agency

Mr. Robert Perciasepe
Assistant Administrator for Water
Water Docket MC-4101
Environmental Protection Agency
Room L102
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May 3, 1994

Dear Mr. Perciasepe:

I have enclosed comments on the January 18, 1994 proposed "Sediment Quality Criteria for the Protection of Benthic Organisms" (59 Fed Reg No. 11, at 2652). These comments are the consensus position of the Sediment Quality Criteria Working Group of the recently-formed Great Lakes Sediment Task Force.

The Great Lakes Sediment Task Force is composed of staff from the eight Great Lakes States and EPA Regions 2 and 5; it has undertaken to address measures that would lead to efficient and effective sediment management and cleanup in the Great Lakes Basin. One of the first activities the group identified as a priority was to provide consolidated Great Lakes Basin comments on the proposed Sediment Quality Criteria documents. A list of the Sediment Quality Working Group members is enclosed. I am the interim chair of this Working Group.

Further background on this consolidated sediment management effort is as follows: The "Great Lakes Water Quality Guidance" (58 Fed Reg 72, at 20802) is a proposed rule that would establish uniform water quality criteria for the Great Lakes system. The proposed implementation procedures for the water quality criteria will be focused primarily on water point source dischargers. Yet, it is known that other sources, including sediments, contribute loadings of toxics to the Great Lakes. In recognition of this, USEPA and the Great Lakes States and Tribes have proposed an approach to address other sources of toxics to the Great Lakes, including sediment, air deposition, combined sewer overflows and urban runoff, spills, and waste sites. This project is known as the "Great Lakes Toxics Reduction Effort".

Please note that individual States or Regions may provide additional comments under separate cover. On behalf of the Task Force and the Minnesota Pollution Control Agency, I hope you will find these comments useful.

Sincerely,

Mary K. Schubauer-Berigan

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Sediment Quality Criteria Working Group
Great Lakes Sediment Task Force

Comments on the "Sediment Quality Criteria for the Protection of Benthic Organisms" Contained in Federal Register Notice of January 18, 1994

May 3, 1994

The proposed Sediment Quality Criteria (SQC) are protective of some benthic components; however, other trophic levels and exposure routes need to be examined in a total sediment quality assessment. The limitations of the approach proposed by the Environmental Protection Agency in this document are recognized by the document itself. The criteria also do not necessarily represent the final concentrations that must be achieved through sediment remediation or pass/fail standards for dredged material management. The SQC numbers should be used as one tool in a multi-phased site assessment to derive such remediation or dredged material management objectives.

Because of these limitations, we have the following specific comments on the use of SQC:

1. The use of SQC as Applicable or Relevant and Appropriate Requirements (ARARs) should be left to the discretion of the States and Regions. If the SQC are considered for use as ARARs by a State or Region, the Task Force recommends inclusion of the phrase "unless other criteria are demonstrated as needed to be protective...".

2. The use of SQC in Congressional language contained in the Superfund and Clean Water Act Reauthorizations should be restricted to "as a factor to be considered".

3. The Great Lakes States and Regions must be involved throughout the development of the proposed "User's Guide" to SQC. Resources may be needed to allow the states and Regions to participate fully in this process.

4. The "User's Guide" should contain a process/decision tree describing a consistent procedure to create cleanup numbers using the SQC. In creating the process/decision tree, other approaches currently in use should also be considered, including, but not limited to:

   - Wisconsin DNR Approach
   - Great Lakes National Program Office Integrated Assessment Approach
   - The "Tiered" Approach to Dredging Material Decision-Making Reflected in the Green Book, Inland and Great Lakes Manuals
   - IJC Remedial Action Plan "Triad-Based" Approach
   - Recent Environmental Science and Technology article

   Copies of these documents are attached.

5. The pace of sediment quality criteria development could have an effect on the adoption by states or regions of water quality criteria for dissolved metals. The technical basis for using dissolved metals criteria is dependent on the concurrent application of sediment quality criteria for metals; therefore, we believe it is premature to promulgate dissolved metals criteria for water.

6. Sediment quality guidelines are badly needed for the chemicals that are the primary subject of regulatory and remediation efforts in the Great Lakes Basin and elsewhere in the nation. We

recognize that dioxin and dioxin-like PCB congeners are currently on the "fast track" for sediment criteria development, and we fully support this effort. In addition, we strongly recommend that the following chemicals, listed in order of importance, be given high priority in the SQC development process:

- Total PCBs (measured as Aroclors)
- Mercury
- Other heavy metals (Cd, Pb, Ni, As, Cu, Cr and Zn), beginning with the most toxic among them
- PAHs not already proposed, beginning with the most toxic among them; and some guidance for total PAHs

The Great Lakes Sediment Task Force feels strongly enough about the need for consistent, valid approaches for the above-listed chemicals that it has begun working on an interim methodology to develop sediment quality criteria and cleanup objectives for PCBs, applicable to the entire Great Lakes system. The Task Force will forward further information on this approach as the methodology is refined.

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Newsletter 1994

WINTER ENVIRONMENTAL ENGINEERS AND SCIENTISTS 1994

TOXICITY REDUCTION EVALUATIONS

INTRODUCTION

The design of most municipal and industrial wastewater treatment facilities has traditionally been based on the removal of conventional pollutants such as biochemical oxygen demand (BOD), total suspended solids (TSS) and ammonia-nitrogen. Many industries also must comply with specific categorical treatment standards which regulate certain metals and/or organics. These and the more recent incorporation of whole effluent toxicity limits into discharge permits have significantly influenced the design basis of many wastewater treatment facilities.

The allowable level of whole effluent toxicity is generally unique to each discharge. A water quality based criterion is a function of the receiving water classification (designated use) and the degree of dilution achieved at the outfall or edge of a mixing zone. Limits can be established for acute (short term) or chronic (long term) toxicity. Very low toxicity limits are generally applied to highly protected waters or effluent dominated (low level of dilution) receiving waters. Toxicity limits are specified for specific test organisms and one or more test organisms can be included in a discharge permit.

Whole effluent toxicity is increasingly being incorporated into many discharge permits. In some instances, in spite of excellent compliance records with conventional and categorical standards, plants may find that they produce an effluent in violation of the toxicity limit. Compliance with conventional parameter limits and even priority pollutant limits does not guarantee a non-toxic effluent.

Determination of Toxicant Characteristics

In many cases where effluent toxicity is found, it is difficult to quickly identify the source. Procedures have been developed to classify the toxicity based on reaction and equilibria characteristics. Toxicity reduction evaluations (TRE's) and toxicity identification evaluations (TIE's) use bench scale laboratory techniques to fractionate the characteristics of the effluent. Effluent samples are sequentially treated by different methods in an attempt to characterize the class of compound(s) responsible for the toxicity. These methods and the principal class of compounds that are affected are presented in Table 1.

The treatment methods are not limited to this list. If a particular compound, or class of compounds, is suspected, a treatment method specific to the compound(s) should also be tested. In general the treatment methods either remove a class of compounds or change the compounds characteristics to a non-toxic nature.

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SEDIMENT QUALITY CRITERIA

INTRODUCTION

During the mid-1980's HydroQual became involved with the development of methodologies for setting sediment quality criteria (SQC). This has been a multi-disciplinary effort drawing on professionals from many organizations and from a wide array of disciplines, including aquatic biology, chemistry, toxicology, mathematics and environmental engineering. In view of the diversity of backgrounds and areas of technical expertise involved, HydroQual has been responsible for coordinating these efforts so that results achieved by each group can be readily melded together into a cohesive framework. We have coordinated and been actively involved in the design of field and laboratory experiments, interpretation of data, and development of summary reports submitted for review by the EPA Science Advisory Board. During this time we have also worked in close cooperation with EPA personnel on the five draft SQC documents published to date and on the establishment of interim SQC for approximately 30 organic chemicals. Current efforts are directed at developing criteria documents for additional organic chemicals and at developing methods for setting SQC for metals. The following is a brief description of the methods used to derive organic chemical and metals SQC. More detailed reviews, which include a description of the equilibrium partitioning (EqP) approach which SQC are based on, are available elsewhere (Di Toro et al., 1991a).

Equilibrium Partitioning

It has been observed that chemical bioavailability and toxicity varies dramatically across sediments. Therefore, it is critical that this variation be accounted for. For non-ionic organic chemicals, this is accomplished by establishing the SQC on the basis of the organic carbon content of the sediment. The resulting SQC are numerical chemical concentrations which are predictive of biological effects and are applicable to varying sediment types.

It has been found experimentally that organism response is the same for either water-only exposures, or for sediment-pore water exposures. The two exposure regimes are shown in Figure 1. The effects concentration found for pore water in the sediment-pore water exposures (right) is essentially equal to that found in water only exposures (left).

It has also been found that the concentration-response curves for pore water exposures correlate equally well with the sediment-chemical concentration on a sediment-organic

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Toxicity Reduction Evaluations

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Table 1. Classes of Compounds Affected by Typical TRE/TIE Treatment Methods

					Organics	
	Ammonia	Chlorine	Metals	Other Inorganics	Volatile	Non-Volatile
pH adjustment	X		X			
Filtration				X		
pH adjustment/ filtration			X	X		
Aeration	X	X	X		X	
pH adjustment/ aeration	X	X	X		X	
Chelation			X			
Oxidation/ Reduction		X		X		
Cation/Anion exchange	X	X	X	X		
Adsorption		X	X		X	X

Adjustment of pH is effective on compounds that dissociate under different pH conditions. An example of this is ammonia; it will be present in the ionized or un-ionized form as a function of pH:

$$NH_3 + H^+ <=> NH_4^+$$

Un-ionized ammonia (NH_3) which is prevalent at high pH (greater than 8.0), is the toxic species. Several metals also dissociate to different valence states and comlexes as a function of pH, some of which may be toxic or non-toxic.

Filtration is simply a mechanical means of removing particulates or suspended solids and any potentially toxic material associated with the solids. Adjustment of pH to a level that causes precipitation of specific inorganic or organic species, followed by filtration can affect the toxicity of a wastewater. Aeration can provide oxidation of metals and other inorganics such as sulfide, sulfite and nitrite and is also a means of stripping volatile compounds from solution. Coupling pH adjustment with aeration provides for removal of species which are more volatile under specific pH conditions. For example, free ammonia is strippable at pH levels greater than 9.0.

Chelation, generally using EDTA, is a means of complexing many metals. A reduction of toxicity by chelation suggests that metals are a component of the toxicity. Chemical oxidation and/or reduction can be used to oxidize residual inorganics and some organics. Oxidation of sulfite, nitrite and sulfide can be achieved with hydrogen peroxide. Oxidation of metals may also occur. Reduction of residual oxidants such as chlorine can be accomplished with reducing agents such as sodium thiosulfate.

Anion and cation exchange resins can be used to selectively remove ions from solution. This is an effective method of removing metals, ammonia, and many other inorganic ions, depending on the resin chosen. Adsorption is an effective means of removing organics, and some oxidants (chlorine) and trace metals. The adsorption media can be activated carbon or a C18 extraction column.

With some knowledge of the major wastewater sources, the unit operations of the treatment facility and its effluent charactristics, these and other test methods can be integrated into a sequence that selectively eliminates suspected classes of compounds. In a TRE or TIE, the toxicity of the raw effluent is first determined to establish a baseline toxicity level. Samples of effluent are then treated by the methods described above and subjected to similar toxicity assays. The results obtained from the treated samples enable one to identify characteristics of the compounds which may be causing the toxicity. For example, reduced toxicity after chelation by EDTA suggsts that metals may be causing the toxicity; reduced toxicity after aeration suggests that effluent toxicity may be due to volatile compounds.

Selection of Bioassay Test Species

In initial screening tests, simplified bioassay techniques can be used to determine toxicity. Examples are Microtox[T] or screening assays using Ceriodaphnia dubia. These procedures are relatively quick and are more economical than the traditional finfish studies. It may be necessary to develop a correlation of the simplified bioassay method to the actual test organism(s) required in the discharge permit. Confirmatory bioassays using the test species identified in the permit should always be done once one has identified potential treatment through the screening procedures.

Study Approaches

POTW's or industrial treatment facilities which exhibit effluent toxicity have two options. They can try to identify and control the source, or they can investigate modified or alternative treatment methods to reduce the toxicity. The source of the toxicity may be from treatment plant operations such as sidestream processing, scrubber returns, or disinfection procedures. Often, the cause is from an upstream impact; this may be an individual source, two or more sources producing synergistic effects, or toxicity may be caused by many incremental discharges to the collection system. While source control is generally desirable, it can at times, be a very difficult task to accomplish, particularly when toxicity is the result of multiple, sometimes intermittent and often unidentifiable sources.

A procedure that is often used to identify the source of toxicity, without having to necessarily identify the responsible compound or class of compounds, involves collecting sample of wastewater from major area tributaries to the treatme plant. These samples from major trunk lines that service specific collection areas can be collected. Laboratory bench scale treatment units that simulate the full-scale plant are used to provide equivalent levels of treatment to the selected area wastewaters. Toxicity is determined for each of the treated effluents. These results can help one to identify which area of the collection system contains wastewaters that are contributing to or causing toxicity in the full-scale plant effluent. A similar procedure is then used to step back up through the trunk line collection points to narrow down the potential sources and, ideally, to identify the responsible discharger.

Role of Biological Treatment in Toxicity Reduction

Biological treatment can be a very successful means of reducing whole effluent toxicity. The fate of toxics through

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Sediment Quality Criteria

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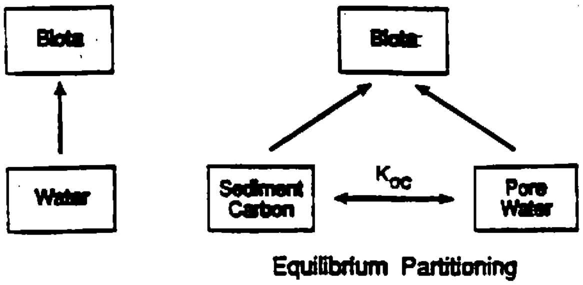
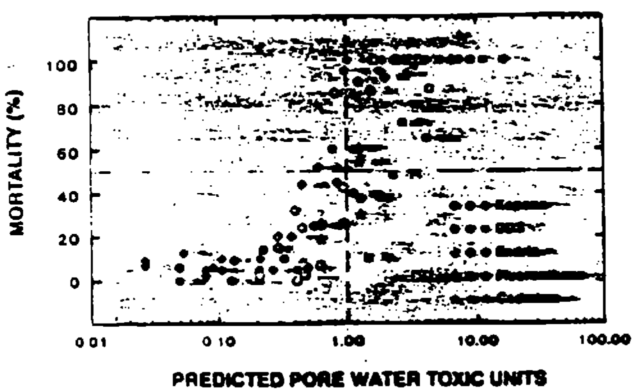


Figure 1. Comparison of Two Biota Exposure Regimes: Water Only (left) and Sediment-Pore Water (right).

carbon basis. Figure 2a presents mortality data for various chemicals, organisms and sediments compared to a pore water toxic unit, which is defined as the ratio of pore water concentration to the water-only LC50.

These observations can be understood by assuming that the pore water and sediment carbon are in equilibrium and that the concentrations are related by a partition coefficient, K_{oc}, as shown in Figure 1 (right). The idea behind the equality of water-only and sediment-exposure effects concentrations on a pore water basis is that the sediment-pore water equilibrium system (right) provides the same exposure as a water-only exposure (left). The reason is that the chemical activity is the same in each system at equilibrium.

2a



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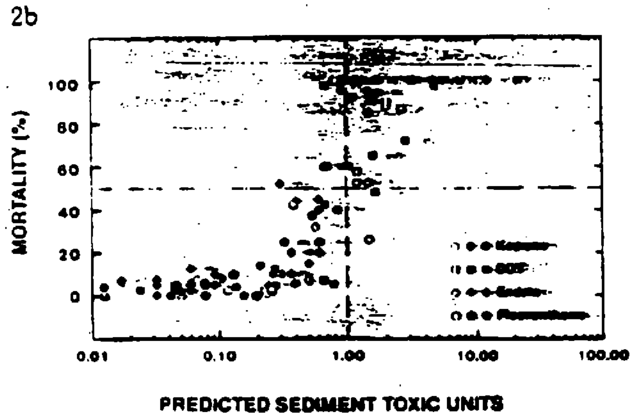

Figure 2. Dose - Response Curves Based on Pore Water (top) and Organic Carbon (bottom) Normalization.

The chemical concentration either in the pore water or bound to sediment organic carbon is dependent on the equilibrium state of the sediment-pore water system. Therefore, partitioning of chemicals between the liquid and sediment phase is an important property. Since analyses of the available acute toxicity data also indicate that benthic organisms exhibit the same sensitivity as water column organisms, it is reasonable to apply the final chronic value, FCV (μg/L) from water quality criteria (WQC) documents as the effects concentration for benthic organisms. This application along with partitioning characteristics of a chemical provide the tools from which the SQC (μg/kg sediment) is computed as follows:

$$SQC = K_p FCV$$

The partition coefficient, K_p(L/kg sediment), is computed using the organic carbon partition coefficient, K_{oc} (L/kg sediment organic carbon), and the organic carbon level of the particular sediment, f_{oc} (g organic carbon/g sediment), as follows:

$$K_p = f_{oc} K_{oc}$$

It has been found that K_{oc} can be estimated from the octanol-water partition coefficient, K_{ow}, of the chemical. The relationship is as follows:

$$\log_{10} K_{oc} = 0.00028 + 0.983 \log_{10} K_{ow}$$

As part of the SQC development effort, HydroQual has been involved with the EPA Athens laboratory in establishing appropriate K_{ow} values for use in setting SQC.

Figure 2b presents mortality data for various chemicals, organisms and sediments compared to a sediment toxic unit defined as the ratio of sediment chemical concentration on an organic carbon normalized basis to the predicted sediment LC50 using K_{oc} and the water-only effects concentration.

Figures 2a and 2b summarize the equilibrium partitioning theory. Both predicted pore water toxic units and predicted sediment toxic units follow a similar concentration-response curve. The response curve indicates that 50% mortality occurs at about one toxic unit independent of chemical, species of organism, or sediment type. The response curves demonstrate the validity of applying effects concentrations obtained from water only exposures, such as the final chronic value from the WQC, to pore water and also to sediment concentrations on an organic carbon normalized basis. As the partition coefficient increases, (i.e. the greater the chemical binds to the sediment organic matter) the sediment toxic units decrease or conversely the chemical concentration to produce 50% mortality at one toxic unit also increases. This indicates that the chemical becomes less bioavailable and hence less toxic and highlights the importance of chemical-sediment binding in developing SQC.

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Toxicity Reduction Evaluations

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biological treatment processes is impacted by biological degradation, adsorption to particulate and dissolved organic carbon and volatilization. Many organics which are toxic to higher organisms, such as the bioassay test organisms, can be removed by conventional biological treatment. In some instances these compounds may be resistant to treatment, but given a long enough exposure to an acclimated biological system, these compounds often can be degraded. Removal of substances responsible for effluent toxicity can usually be maximized through a combination of increasing sludge age (SRT) and reducing food to mass (F/M) loading as shown in Figure 1. These conditions may also promote nitrification. The high sludge age promotes acclimation to the waste or the compound exerting the toxicity. The reduced F/M loading extends the time that these compounds are exposed to biological treatment.

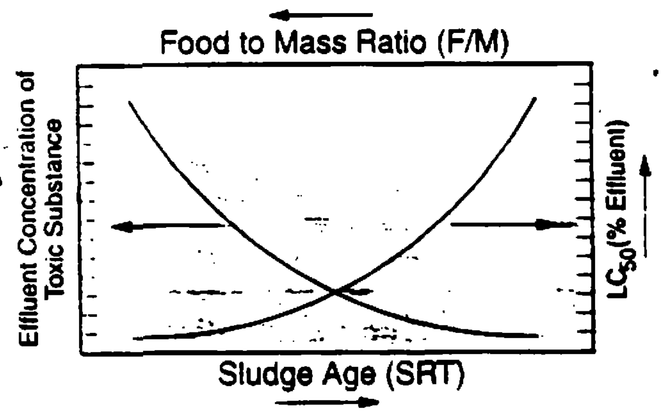

Figure 1. Relationships of Toxicant Effects with F/M and SRT

An alternative to conventional biological treatment is the powdered activated carbon treatment process (PACT), whereby powdered activated carbon is added directly to an activated sludge system. The process takes advantage of the adsorption capacity of carbon in the biological treatment of toxic or inhibitory wastewaters. Compounds that are not easily biodegraded may be adsorbed to the carbon. The compounds either accumulate on the carbon until its capacity is exhausted, or slowly desorb and are biodegraded. Figure 2 shows a comparison of the effluent toxic concentration to SRT for conventional biological treatment and the PACT process. Generally the PACT process can provide a better

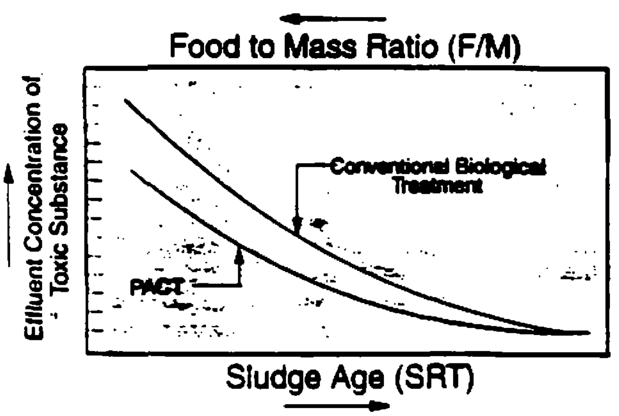

Figure 2. Impact of PACT Process on Toxicant Removals

quality, less toxic effluent at lower SRTs due to the carbon's ability to adsorb substances. Both processes perform similarly at high SRTs.

For many wastewater treatment facilities with a biological treatment process, compliance with effluent toxicity criteria may be as simple as revising the operating strategies of the plant. For plants not operating at full design load, there is usually some capacity to increase biological inventory and SRT to improve removals of the toxic substance. Additionally, TRE's or TIE's can be conducted to identify and isolate the source, which can then either be regulated or surcharged for added plant operations costs and the cost of modifications necessary to remove the toxicity.

Case Studies

Several studies have been performed which highlight a particular facet of toxicity investigations.

Case 1

A regional wastewater treatment plant handling a largely industrial waste exhibited an excellent compliance record for convential parameters; however, bioassay studies revealed evidence of effluent toxicity. A TIE indicated that the toxicity was due to ammonia, as well as specific organics, and laboratory bench-scale biological treatment studies defined the collection area that was contributing the toxic organi--

Pilot-scale activated sludge treatment studies (which in porated PACT) were undertaken to develop design criteria for nitrification, and to characterize effluent toxicity of fully and partially nitrified effluents. During start-up and acclimation, nitrite build-up was observed due to ammonia toxicity on **nitrobacter**, the autotrophic organisms responsible for conversion of nitrite to nitrate. Once ammonia-nitrogen levels dropped below 100 mg/L, the nitrite build-up subsided and complete nitrification gradually developed. The extended level of treatment obtained at an SRT of 20 days not only reduced ammonia toxicity to acceptable levels, but also the toxicity associated with specific organic compounds. The facility is now being upgraded for nitrification.

Case 2

An organic chemicals manufacturing plant wished to expand production of an algicide product, which would consequently increase wastewater loads to the local POTW servicing the plant. The POTW required the industrial user to demonstrate the impact of the additional load on the treatment plant. The manufacturer also used this opportunity to develop toxicity information on biologically treated effluents at various production levels. The studies demonstrated that no acute toxicity was experienced in the treated effluent at any wastewater load tested. Chronic toxicity did increase with increasing load. The study concluded that projected increases in production would not contribute to acute toxicity in the POTW effluent and established production limits that would ensure that the POTW would not exceed chronic toxicity limits.

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Sediment Quality Criteria

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Application to Toxic Metals

The theory of chemical-sediment binding also applies to metals in sediments. HydroQual has been actively involved in the development of methods for deriving SQC for metals. For example, the primary binding phase for cadmium and nickel has been found to be the acid volatile sulfide phase (AVS) - the solid phase sediment sulfides that are soluble in cold acid (Di Toro et al., 1990; Di Toro et al., 1991b). The reason is that acid volatile sulfide reacts with cadmium and nickel to form sulfide precipitates, thereby reducing their bioavailability. This is demonstrated in Figure 3 where mortality is related to the simultaneously extracted metal concentration (SEM) to AVS molar ratio for cadmium and nickel for two marine organism and three marine sediments.

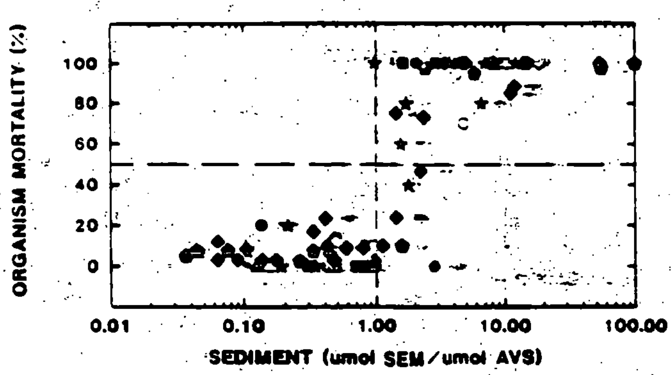

Figure 3. Acute Toxicity of Cadmium and Nickel: Acid Volatile Sulfide Normalization.

These data indicate that if the ratio [SEM]/[AVS] = 1 is used to discriminate toxic from non-toxic sediments (greater or less than 50% mortality respectively), then for the 117 experiments represented by these data 51% are correctly classified as non-toxic (bottom left quadrant of Figure 3) and 42% are correctly classified as toxic (top left quadrant). The 7% that are incorrectly classified as toxic (bottom right quadrant) result from the assumption that metal activity will invariably be high enough to cause toxicity if [SEM]/[AVS] > 1. It is possible that other ligands, associated with sediment sorption for example, are reducing the metal activity below the effects level for the test organism. Also, less sensitive organisms can tolerate the increased metal activity even if [SEM]/[AVS] > 1. If a more conservative interpretation is adopted and the criteria [SEM]/[AVS] < 1 is used only to predict the non-toxic sediments, then all experiments are correctly classified. These conclusions are directly attributable to the excess AVS in the sediment which assures that the metal activity in the sediment-interstitial water system is below the effects activity for the organisms tested. HydroQual and other scientists are currently focusing attention on further development of SQC for metals.

Sediment quality criteria are intended to protect benthic organisms from the effects of chemicals associated with the sediment. SQC are suitable for use in providing guidance to regulatory agencies because they are numerical values, chemical specific, applicable to most sediments, predictive of biological effects and protective of benthic organisms. Some areas where SQC have been proposed for use are as follows: SQC can be used as a preliminary test in a tiered testing approach to sediment assessment in EPA prevention, remediation and dredged material disposal programs. SQC can be used to assess the extent of contamination and as indicators of areas that are at risk of becoming contaminated. SQC can be used to assess and regulate the impacts of dischargers on the sediment using mathematical model techniques. SQC can be used to assess the impact of remediation alternatives.

In summary HydroQual is part of a team of experts that is involved in further research for the development of SQC for organic chemicals and metals in contaminated sediments. The EqP methodology forms the basis upon which the SQC are being developed. The process leading to final registration of any new criteria limits involves extensive review by EPA, the scientific community and the public.

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Case 3

An organic chemicals manufacturer suspected that a particular production area contributed materials which exerted inhibitory effects on its wastewater treatment plant and subsequent permit excursions. Respirometry studies were conducted on wastewaters from the major production areas; these indicated that the suspected process suppressed oxygen uptake rates on a biological seed. Continuous flow bench-scale studies were performed to screen the impact of the current and future wastewaters on the plant's activated sludge system. Single and two-stage biological treatment systems were evaluated. The results indicated that under current and projected wastewater loadings, either a single or two-stage activated sludge plant, when operated at the specified SRT, F/M and basin dissolved oxygen concentrations could produce the desired effluent. This included compliance with specific categorical organics limitations.

Each of these cases histories involved the elimination of effluent toxicity or the inhibitory impacts of wastewaters on biological treatment systems. The chemical compounds causing the effluent toxicity were identified in some instances. In others, the overall source was identified, without explicitly identifying the toxic constituent. In each case, enhanced biological treatment or modified operating strategies were effective in controlling effluent toxicity or biological inhibition such that the facilities produced the desired effluent quality. Toxicity investigations can be challenging; however, with a clear understanding of the problem, and with the knowledge and experience that has been developed, HydroQual can design and implement effective programs to provide feasible solutions. The need for these types of investigations is expected to expand as regulatory agencies further implement categorical limits and enforce whole effluent toxicity criteria.

Recent Presentations by HydroQual Personnel:

Alan F. Blumberg: Modeling the Tides of Massachusetts and Cape Cod Bays. Presented at Hydraulic Engineering '93, San Francisco, CA, July 1993.

Dominic M. Di Toro: Mass Transfer Model of Sediment Nutrient and Oxygen Fluxes. Presented at Sixth International Symposium on The Interactions Between Sediments and Water, Santa Barbara, California, December 1993.

Eugene J. Donovan: Evaluation of Oxidation Ditches for Nutrient Removal. Presented at U.S. Environmental Protection Agency Wastewater Treatment Technology Transfer Workshop, Kansas City, Missouri, April 1993.

Eugene D. Driscoll: Assessment of BMPs Being Used in the U.S. and Canada. Presented at Sixth International Conference on Urban Storm Drainage, Niagara Fall, Ontario, Canada, September 1993.

Thomas J. Mulligan: Upgrading Small Community Wastewater Treatment Systems for Nitrification. Presented at the U.S. Environmental Protection Agency Symposium on Small Community Wastewater Treatment, Kansas City, Kansas, 1991.

Donald J. O'Connor: Progress in Perspective. Keynote presentation at 62nd Annual Meeting and Exhibition, New York Water Pollution Control Association, New York, January 1990.

Paul R. Paquin: The Effect of Partition Coefficient Measurement on Pesticide Exposure Assessments and Aquatic Risk Assessments. Presented at SETAC, Houston, Texas, November 1993.

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John P. St. John: Testimony on "The Status of the Long Island Sound Water Quality Model" before the Long Island Sound Caucus, U.S. House of Representatives, Washington, D.C., March 1993.

C. Kirk Ziegler: Importance of Sediment Transport to the Fate of HOCs in Surface Water Systems. Presented at Sixth International Symposium on The Interactions Between Sediments and Water, Santa Barbara, California, December 1993.

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Announcement

The American Academy of Environmental Engineers has just informed **Donald J. O'Connor** that he has been awarded Honorary Diplomate status in their Academy. Since its founding in 1955, the Academy has seen fit to extend this honor to only four others — Stanley E. Kappe, Abel Wolman, Daniel A. Okun and Arthur C. Stern. The award will be presented at the Academy's Awards Luncheon which will be held April 14, 1994 at the National Press Club in Washington, D.C.

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